



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/660,573	09/12/2003	Ming-Tsong Wang	0941-0841P	5290

2292 7590 04/05/2005

BIRCH STEWART KOLASCH & BIRCH
PO BOX 747
FALLS CHURCH, VA 22040-0747

EXAMINER

MALDONADO, JULIO J

ART UNIT	PAPER NUMBER
----------	--------------

2823

DATE MAILED: 04/05/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/660,573

Applicant(s)

WANG ET AL.

Examiner

Julio J. Maldonado

Art Unit

2823

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 05 October 2004.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,2,5,7-9,11,15,16,18-25 and 34-40 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,2,5,7-9,11,15,16,18-25 and 34-40 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

1. Applicants' cancellation of claims 3, 4, 6, 26 and 29-33 in paper filed on 12/09/2004 is acknowledged.
2. The rejection as set forth in the Office Action mailed on 10/05/2004 is withdrawn in view Applicants' amendments.
3. Claims 1, 2, 5, 7-9, 11, 15, 16, 18-25 and 34-40 are pending in the Application.

Continued Examination Under 37 CFR 1.114

4. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 12/09/2004 has been entered.

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

6. Claims 1, 2, 7-9, 11, 15, 16, 18, 19, 21-25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ngo et al. (U.S. 2002/0162736 A1) in view of Wu et al. (U.S. 2003/0022513 A1).

Ngo et al. (Figs.3-12) teach a related method for forming a metal damascene structure including forming a cap layer (22) on the a metal layer (16), wherein the cap layer (22) is silicon nitride or silicon carbide; forming a dielectric layer (13, 14, 15) on the cap layer (22); etching the dielectric layer (13, 14, 15) and the cap layer (22) to form a damascene opening (16) and expose the first metal layer (10), wherein said etching forms impurities (17, 19) such as polymeric deposits on the exposed first metal layer (10), and wherein the damascene (16) opening is a via having trench; treating the exposed first metal layer (10) using a plasma process comprising an NH_3 plasma and an N_2 and H_2 plasma to remove the impurities (17, 19) thereon; and filling copper (53A) in the damascene opening ([0021] – [0030]).

Ngo et al. fail to teach wherein said etching uses a fluorine-containing plasma or a chlorine containing plasma and wherein said plasma further includes nitrogen and oxygen. However, Wu et al. (Figs.3A-3B) in a related method to form interconnects teaches providing a substrate (300); forming a cap layer (302) on the substrate (300); forming a dielectric layer (306) on the cap layer (302); etching the dielectric layer (306) by means of reactive ion etching using a fluorine-containing plasma recipe, wherein the plasma creates impurities on the dielectric layer (306); and providing a plasma treatment comprising a hydrogen containing gas, a nitrogen containing gas and an oxygen containing gas or mixtures thereof to remove said impurities from the dielectric layer (306) ([0021] – [0035]). It would have been within the scope of one of ordinary skill in the art to combine the teachings of Ngo et al. and Wu et al. to enable the etching process of Ngo et al. to be performed according to the teachings of Wu et al. because

Art Unit: 2823

one of ordinary skill in the art at the time the invention was made would have been motivated to look to alternative suitable methods of performing the disclosed etching process of Ngo et al. and art recognized suitability for an intended purpose has been recognized to be motivation to combine. MPEP 2144.07. It would also have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of Ngo et al. and Wu et al. to enable using nitrogen gases and oxygen gases as part of the plasma treatment as taught by Wu et al. in the plasma treatment of Ngo et al., because this would facilitate the contaminant removal process in Ngo et al. (Wu et al., [0024]).

7. Claims 5 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ngo et al. (U.S. 2002/0162736 A1) in view of Wu et al. (U.S. 2003/0022513 A1) as applied to claims 1, 2, 7-9, 11, 15, 16, 18, 19, 21-25 above, and further in view of Seshan et al. (U.S. 6,352,940 B1).

The combined teachings of Ngo et al. and Wu et al. substantially teach all aspects of the invention but fail to teach wherein said plasma further includes N_2O . However, Seshan et al. teach a method of treating a substrate surface teach treating dielectric and conductive surfaces with a plasma comprising N_2O , wherein said N_2O plasma is a well-known agent to clean surfaces from contaminants such as hydrocarbons and fluorine residues from etching processes (Seshan et al., column 6, line 34 – column 7, line 10). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of Ngo et al. and Wu et al. with Seshan et al. to enable adding N_2O as a cleaning agent in the

Art Unit: 2823

process of Ngo et al. and Wu et al. as taught of Seshan et al., because N_2O plasma is a well-known agent to clean surfaces from contaminants such as hydrocarbons and fluorine residues from etching processes (column 7, lines 3 – 10).

8. Claims 34, 35 and 37-40 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ngo et al. (U.S. 2002/0162736 A1) in view of Wu et al. (U.S. 2003/0022513 A1) and Huang (U.S. 2002/0054962 A1).

Ngo et al. (Figs.3-12) teach a related method for forming a metal damascene structure including forming a cap layer (22) on the a metal layer (16), wherein the cap layer (22) is silicon nitride or silicon carbide; forming a dielectric layer (13, 14, 15) on the cap layer (22); etching the dielectric layer (13, 14, 15) and the cap layer (22) to form a damascene opening (16) and expose the first metal layer (10), wherein said etching forms impurities (17, 19) such as polymeric deposits on the exposed first metal layer (10), and wherein the damascene (16) opening is a via having trench; treating the exposed first metal layer (10) using a plasma process comprising an NH_3 plasma and an N_2 and H_2 plasma to remove the impurities (17, 19) thereon; and filling copper (53A) in the damascene opening ([0021] – [0030]).

Ngo et al. fail to teach wherein said etching uses a fluorine-containing plasma or a chlorine containing plasma and wherein said plasma further includes nitrogen and oxygen. However, Wu et al. (Figs.3A-3B) in a related method to form interconnects teaches providing a substrate (300); forming a cap layer (302) on the substrate (300); forming a dielectric layer (306) on the cap layer (302); etching the dielectric layer (306) by means of reactive ion etching using a fluorine-containing plasma recipe, wherein the

Art Unit: 2823

plasma creates impurities on the dielectric layer (306); and providing a plasma treatment comprising a hydrogen containing gas, a nitrogen containing gas and an oxygen containing gas or mixtures thereof to remove said impurities from the dielectric layer (306) ([0021] – [0035]). It would have been within the scope of one of ordinary skill in the art to combine the teachings of Ngo et al. and Wu et al. to enable the etching process of Ngo et al. to be performed according to the teachings of Wu et al. because one of ordinary skill in the art at the time the invention was made would have been motivated to look to alternative suitable methods of performing the disclosed etching process of Ngo et al. and art recognized suitability for an intended purpose has been recognized to be motivation to combine. MPEP 2144.07. It would also have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of Ngo et al. and Wu et al. to enable using nitrogen gases and oxygen gases as part of the plasma treatment as taught by Wu et al. in the plasma treatment of Ngo et al., because this would facilitate the contaminant removal process in Ngo et al. (Wu et al., [0024]).

The combined teachings of Ngo et al. and Wu et al. also teach using a resist to perform the patterning of the dielectric layer (Wu et al., [0028]), but fail to expressly teach wherein said resist contains carbon. However, Huang in a related method to form an interconnect structure teaches using organic photoresists as part of the patterning process in the formation of said interconnects (Huang, [0004]). It would have been within the scope of one of ordinary skill in the art to combine the teachings of Ngo et al. and Wu et al. with Huang to enable patterning the dielectric layer of Ngo et al. and Wu

Art Unit: 2823

et al. according to the teachings of Huang because one of ordinary skill in the art at the time the invention was made would have been motivated to look to alternative suitable methods of performing the disclosed patterning step of Ngo et al. and Wu et al. and art recognized suitability for an intended purpose has been recognized to be motivation to combine. MPEP 2144.07.

9. Claim 36 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ngo et al. (U.S. 2002/0162736 A1) in view of Wu et al. (U.S. 2003/0022513 A1) and Huang (U.S. 2002/0054962 A1) as applied to claims 34, 35 and 37-40 above, and further in view of Seshan et al. (U.S. 6,352,940 B1).

The combined teachings of Ngo et al., Wu et al. and Huang substantially teach all aspects of the invention but fail to teach wherein said plasma further includes N₂O. However, Seshan et al. teach a method of treating a substrate surface teach treating dielectric and conductive surfaces with a plasma comprising N₂O, wherein said N₂O plasma is a well-known agent to clean surfaces from contaminants such as hydrocarbons and fluorine residues from etching processes (Seshan et al., column 6, line 34 – column 7, line 10). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of Ngo et al., Wu et al. and Huang with Seshan et al. to enable adding N₂O as a cleaning agent in the process of Ngo et al., Wu et al. and Huang as taught of Seshan et al., because N₂O plasma is a well-known agent to clean surfaces from contaminants such as hydrocarbons and fluorine residues from etching processes (column 7, lines 3 – 10).

Response to Arguments

10. Applicant's arguments with respect to claims 1, 2, 5, 7-9, 11, 15, 16, 18-25 and 34-40 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

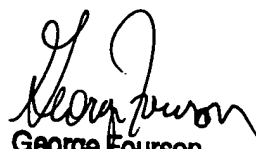
11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to examiner Julio J. Maldonado whose telephone number is (571) 272-1864. The examiner can normally be reached on Monday through Friday.

12. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri, can be reached on (571) 272-1855. The fax number for this group is 703-872-9306 for before final submissions, 703-872-9306 for after final submissions and the customer service number for group 2800 is (703) 306-3329.

Updates can be found at <http://www.uspto.gov/web/info/2800.htm>.

Julio J. Maldonado
Patent Examiner
Art Unit 2823

Julio J. Maldonado
March 30, 2005


George Fourson
Primary Examiner